In situ Mass Diffusivity Measurement Technique

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We have developed a technique for the measurement of diffusivities in liquids over a wide temperature range. A radiotracer, initially located at one end of the cylindrical diffusion sample, is used as the diffusant. The sample is positioned in a concentric isothermal radiation shield with collimation bores located at defined positions along its axis. The intensity of the radiation emitted through the collimators is measured *vs.* time with solid state detectors and associated energy discrimination electronics. Diffusivities are calculated from the signal difference between pairs of collimation bores. Self-diffusivities obtained with In/In^{114m} in space and on Earth illustrate the high precision obtainable with this technique. The In/In^{114m} space data were close to the ground results, however, the data scatter was much less. By employing a tracer that emits photons of different energy, and thus, different self-absorption, transport in the bulk of the sample can be distinguished from that in the proximity of the wall. No difference was found. Because of the mathematical algorithm used in this technique the diffusivity at several temperatures can be measured utilizing a single sample. In support of this work 2-D numerical modeling of the effect of various blockages on the concentration profile and the resulting apparent diffusivity were conducted. For the methodology that we use very little effect was seen except in the case of *extreme* blockages. These results have been experimentally verified (using the above two measurement location methodology) with In/In^{114m} diffusion studies. The resulting diffusivity of samples run with blockages of greater than 50% between the radiotracer and host sections and “voids” of greater than 10% were essentially the same as normally run samples. Terrestrial results for other liquid metals will be presented.